

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION RESEARCH AND TECHNOLOGY RESUME	
TITLE	Lunar and Planetary Studies
PERFORMING ORGANIZATION	Division of Geology and Planetary Sciences California Institute of Technology Pasadena, CA 91125
INVESTIGATOR'S NAME	D.O. Muhleman (P.I.), P. Goldreich (Co-P.I.), A.P. Ingersoll (Co-P.I.) and J.A. Westphal (Co-P.I.)
DESCRIPTION (a. Brief statement on strategy of investigation; b. Progress and accomplishments of prior year; c. What will be accomplished this year, as well as how and why; and d. Summary bibliography)	
<p>A) This grant supports the core program in planetary astronomy at Caltech under the direction of Professors Muhleman, Goldreich, Ingersoll and Westphal. The research includes observations in the IR, sub-mm, mm and cm wavelengths at national and Caltech observatories with a strong emphasis on integrating the observations with spacecraft data and with models of atmospheric structure, dynamics and chemistry.</p> <p>B) Muhleman's group have made extensive observations at the VLA of Saturn, Uranus and Neptune which are being interpreted in terms of deep atmospheric structures which are obvious in the 2 and 6 cm maps of Saturn and Uranus. The microwave measurements are one of the few sources of information below the 2 bar level. Ingersoll and Dowling (1988) have used cloud-tracked winds derived from Voyager images to infer the winds at cloud base around the Great Red Spot and white oval BC. The method uses the conservation of potential vorticity, which relates absolute vorticity (an observable) to the pressure thickness of the cloudy layer. Goldreich is investigating the dynamics of narrow rings with postdoctoral fellow, Pierre-Yves Longaretti. Their work has focused on the role of collisional stresses on the precession of the rings, since the Voyager radio science results imply that the previous model based on the ring's self-gravity is not the entire story. In addition Borderies, Goldreich and Tremaine have completed an investigation of the dynamics of the Encke division in Saturn's A ring that is currently being written up.</p> <p>C) In the coming year, Goldreich intends to prepare for the encounter of Voyager 2 with Neptune by extending his model of the Neptune arcs and by initiating a study of the dynamics of Neptune's satellite system. Westphal will begin a Neptune satellite search program with the Planetary Patrol Telescope on Mauna Kea to try to verify Goldreich's theoretical work. Muhleman and Bruce Betts (a graduate student) have time on the 200-inch to study the IR light curve of the Galilean Satellites to search for correlations with albedo and 3 mm brightness temperatures over the orbits of each. Ingersoll and students will be extending their vorticity study to other latitudes in Jupiter and Saturn's atmospheres. Also, they will try to settle an 8-year-old controversy over the transfer of momentum by eddies into (or out of) the zonal jets. Mark Hofstadter and Muhleman will observe Uranus at the VLA at a wavelength of 6 cm. These data (limb darkening curves and latitude variations) will make it possible to better explore the chemistry of NH_3, H_2O and sulfur compounds in the Uranian atmosphere between 1 bar and 10 bars (or more).</p>	

- Achterberg, R.K. and A.P. Ingersoll, Vertical structure in quasi-geostrophic models of Jupiter. *Bull. Amer. Astron. Soc.* **19**, 836, 1987; *J. Atmos. Sci.*, in preparation.
- Berge, G.L., D.O. Muhleman and R.P. Linfield, Very Large Array observations of Uranus at 2.0 cm. In press *Astron. J.*, 1988.
- Berge, G.L., D.O. Muhleman, D. Rudy and R. Lindfield, VLA observations of Uranus at 2.0 cm. Submitted to *Icarus*, 1987.
- Dowling, T.E., and A.P. Ingersoll, Potential vorticity and layer thickness variations in the flow around Jupiter's Great Red Spot and White Oval BC. *J. Atmos. Sci.* **45**, 1380-1396, 1988.
- Friedson, J. and A.P. Ingersoll, Seasonal meridional energy balance and thermal structure of the atmosphere of Uranus: A radiative-convective-dynamical model. *Icarus* **69**, 135-156, 1987
- Goldreich, P. and C.C. Porco, Shepherding of the Uranian Rings. I. Kinematics. *Astronom. J.* **93**, 724-729, 1987.
- Goldreich, P. and C.C. Porco, Shepherding of the Uranian Rings. II. Dynamics. *Astronom. J.* **93**, 730-737, 1987.
- Rudy, D., D.O. Muhleman, G.L. Berge, B. Jakosky and P.R. Christensen, VLA Observations of Mars at 2 and 6 cm: The Northern Hemisphere and North Pole Region. *Icarus* **71**, 159-177, 1987.